

Career & Technical Education (CTE) Standards Revision Project

Cluster: Energy

Pathways: Fossil Energy Extraction, Processing & Distribution, Electromechanical Generation & Maintenance, Electrical Energy Transmission & Distribution, Renewable Energy Production, Energy Efficiency & Environmental Technology

The standards for this cluster area a result of a compilation of Energy standards from State CTE Standards developed in Ohio and California and introductory course standards from Colorado community colleges. The attached standards for each of the pathways identify links to Colorado core content standards which have been validated by content specialists in each of the core content areas.

Michael Womochil, Program Director, Agriculture, Natural Resources & Energy

Career Cluster/Cluster Grouping:	Energy
Pathway(s):	Electromechanical Generation & Maintenance
Prepared Completer Competencies: ENY 03. Explain the generation of electricity by traditional electromechanical methods	
High School Expectations	
Concepts and skills students know include: ENY 03.01 Explain basic electrical theory.	
Evidence Outcomes Students can:	21st Century Skills and Readiness Competencies
<p>ENY 03.01 A Describe atomic structure, the components of the atom and their charges.</p> <p>(SCI 1.2a; SCI 1.2b)</p> <p>ENY 03.01 B Define electricity</p> <p>ENY 03.01 C Compare and contrast DC and AC current</p> <p>ENY 03.01 D Analyze voltage, current and resistance in a circuit</p> <p>ENY 03.01 E Utilize Ohm's Law to calculate voltage, amperes and resistance.</p> <p>(MAT 1.4a SCI1.5b)</p>	<p>Academic Content Knowledge Alignment:</p> <p>SCI1.2.a-Science, Physical Science, Matter has definite structure which determines characteristic physical and chemical properties. - Develop, communicate, and justify an evidence-based scientific explanation supporting the current model of an atom</p> <p>SCI1.2.b-Science, Physical Science, -Gather, analyze and interpret data on chemical and physical properties of elements such as density, melting point, boiling point, and conductivity</p>

ENY 03.01 F Measure voltage, amperes and resistance. (SCI1.5b)	SCI1.5.b-Science, Physical Science, Energy exists in many forms (mechanical, chemical, electrical, radiant, thermal, and nuclear) that can be quantified and experimentally determined. - Use appropriate measurements, equations and graphs to gather, analyze, and interpret data on the quantity of energy in a system or an object
	Learning & Behavioral Skills (Inquiry, Application in Society & Technology & Nature of...):

High School Expectations	
Concepts and skills students know include: ENY 03.02 Analyze series and parallel circuits	
Evidence Outcomes Students can:	21st Century Skills and Readiness Competencies
<p>ENY 03.02 A Distinguish series from parallel circuits.</p> <p>ENY 03.02 B Describe the role and function of resistors (loads).</p> <p>ENY 03.02 C Explain and apply circuit theorems (e.g., superposition, Thevenin's and Norton's theorems).</p> <p>ENY 03.02 D Analyze the operation of components and electrical loads connected in a series and parallel circuit.</p> <p>ENY 03.02 E Calculate voltage, amperes, resistance and power in a series and parallel circuit.</p> <p>(MAT 1.4a)</p> <p>ENY 03.02 F Utilize mesh and node current analysis techniques.</p>	Academic Content Knowledge Alignment:
	Learning & Behavioral Skills (Inquiry, Application in Society & Technology & Nature of...):

High School Expectations	
Concepts and skills students know include: ENY 03.03 Construct series and parallel electrical circuits	
Evidence Outcomes Students can:	21st Century Skills and Readiness Competencies
<p>ENY 03.03 A Identify the source of AC and DC voltage.</p> <p>ENY 03.03 B Trace the path of generated AC and DC voltage from its source to where it is used.</p> <p>ENY 03.03 C Discuss the frequency of AC voltage.</p> <p>ENY 03.03 D Explain the difference between peak voltage and RMS.</p> <p>ENY 03.03 E Explore the effects of a capacitor and inductor in an AC circuit.</p> <p>(SCI 1.5a SCI 1.5d)</p> <p>ENY 03.03 F Calculate the frequency and period of an AC sine wave.</p>	<p>Academic Content Knowledge Alignment:</p> <p>SCI1.5.a-Science, Physical Science, Energy exists in many forms (mechanical, chemical, electrical, radiant, thermal, and nuclear) that can be quantified and experimentally determined - Develop, communicate, and justify an evidence-based scientific explanation regarding the potential and kinetic nature of mechanical energy</p> <p>SCI1.5.d-Science, Physical Science, - Identify different energy forms, and calculate their amounts by measuring their defining characteristics</p>
	Learning & Behavioral Skills (Inquiry, Application in Society & Technology & Nature of...):

High School Expectations	
Concepts and skills students know include: ENY 03.04 Examine transformers, and three-phase and single-phase voltage.	
Evidence Outcomes - Students can:	21st Century Skills and Readiness Competencies
<p>ENY 03.04 A Explain and diagram the operation of a transformer.</p> <p>(SCI 1.5b SCI 1.5d)</p> <p>ENY 03.04 B Contrast the difference between step-up and step-down transformers.</p> <p>ENY 03.04 C Explain how inductance is used in the operation of a transformer.</p> <p>(SCI1.5b)</p> <p>ENY 03.04 D Distinguish between three-phase and single-phase voltage.</p>	<p>Academic Content Knowledge Alignment:</p> <p>SCI1.5.b-Science, Physical Science, Energy exists in many forms (mechanical, chemical, electrical, radiant, thermal, and nuclear) that can be quantified and experimentally determined. - Use appropriate measurements, equations and graphs to gather, analyze, and interpret data on the quantity of energy in a system or an object</p> <p>SCI1.5.d-Science, Physical Science, - Identify different energy forms, and calculate their amounts by measuring their defining characteristics</p>
	<p>Learning & Behavioral Skills (Inquiry, Application in Society & Technology & Nature of...):</p>

High School Expectations	
Concepts and skills students know include: ENY 03.05 Understand energy conversion processes and energy transmission systems used in the electromechanical power generation	
Evidence Outcomes Students can:	21st Century Skills and Readiness Competencies
<p>ENY 03.05 A interpret the theory of basic plant electrical components.</p> <p>ENY 03.05 B Identify the components that make up a power generation system</p> <p>ENY 03.05 C Identify the source of mechanical energy in fossil fuel plants.</p> <p>(SCI 1.3a SCI 1.5b)</p> <p>ENY 03.05 D Interpret the fundamentals of cycles (including vapor and combined power, cogeneration, and Brayton and Rankin cycles) as they relate to energy resources used in the industry</p>	<p>Academic Content Knowledge Alignment:</p> <p>SCI1.3.a-Science, Physical Science, Matter Matter can change form through chemical or nuclear reactions abiding by the laws of conservation of mass and energy. - Recognize, analyze, interpret, and balance chemical equations (synthesis, decomposition, combustion, and replacement) or nuclear equations (fusion and fission)</p> <p>SCI1.4.a Atoms bond in different ways to form molecules and compounds that have definite properties- Develop, communicate, and justify an evidence-based scientific explanation supporting the current models of chemical bonding</p> <p>SCI1.4.d Atoms bond in different ways to form molecules and compounds that have definite properties- Describe the role electrons play in atomic bonding</p>

<p>ENY 03.05 E Diagram how water and steam move through the steam cycle and explain how this movement is monitored and controlled</p> <p>(SCI 1.4a SCI 1.4d)</p> <p>ENY 03.05 F Diagram the water flow path through a typical drum boiler and explain how natural circulation makes this flow possible.</p> <p>ENY 03.05 G Define the terms drum boiler and natural circulation</p> <p>ENY 03.05 H Explain how steam is supplied to a turbine</p> <p>ENY 03.05 I Describe in general terms the operation of a boiler.</p>	<p>SCI1.5.b-Science, Physical Science, Energy exists in many forms (mechanical, chemical, electrical, radiant, thermal, and nuclear) that can be quantified and experimentally determined. - Use appropriate measurements, equations and graphs to gather, analyze, and interpret data on the quantity of energy in a system or an object</p> <hr/> <p>Learning & Behavioral Skills (Inquiry, Application in Society & Technology & Nature of...):</p>
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High School Expectations	
Concepts and skills students know include: ENY 03.06 Analyze nuclear energy as a principle of energy science.	
Evidence Outcomes Students can:	21 st Century Skills and Readiness Competencies
<p>ENY 03.06 A Explain the scientific process of producing nuclear energy.</p> <p>(SCI1.3a SCI 1.3b)</p> <p>ENY 03.06 B Describe the various applications for nuclear energy.</p> <p>(SCI 3.5a SCI 3.5b)</p> <p>ENY 03.06 C Identify and describe the functions of the components in a nuclear facility.</p> <p>ENY 03.06 D Explore and diagram the uranium mining and conversion process for producing nuclear fuel.</p> <p>(SCI3.5a SCI3.5b SCI2.2b)</p> <p>ENY 03.06 E Describe the reprocessing potential of spent nuclear fuel.</p> <p>(SCI3.5a SCI3.5b)</p>	<p>Academic Content Knowledge Alignment:</p> <p>SCI1.3.a-Science, Physical Science, Matter Matter can change form through chemical or nuclear reactions abiding by the laws of conservation of mass and energy. - Recognize, analyze, interpret, and balance chemical equations (synthesis, decomposition, combustion, and replacement) or nuclear equations (fusion and fission)</p> <p>SCI1.3.b-Science, Physical Science, - Predict reactants and products for different types of chemical and nuclear reactions</p> <p>SCI2.2.b-Science, Life Science, The size and persistence of populations depend on their interactions with each other and on the abiotic factors in an ecosystem - Describe or evaluate communities in terms of primary and secondary succession as they progress over time ocean sediment cores, tree rings, cave deposits, native knowledge, and other sources in relation to climate change</p>

<p>ENY 03.06 F Contrast critical fusion reactors to radioisotope thermoelectric generators.</p> <p>ENY 03.06 G Discuss the capacity of nuclear energy to produce and deliver power for energy</p> <p>(SCI 3.6c)</p>	<p>SCI3.5.a-Science, Earth Science, There are costs, benefits, and consequences of exploration, development, and consumption of renewable and nonrenewable resources - Develop, communicate, and justify an evidence-based scientific explanation regarding the costs and benefits of exploration, development, and consumption of renewable and nonrenewable resources</p> <p>SCI3.5.b-Science, Earth Science, - Evaluate positive and negative impacts on the geosphere, atmosphere, hydrosphere, and biosphere in regards to resource use</p> <p>SCI3.6.c-Science, Earth Science, The interaction of Earth's surface with water, air, gravity, and biological activity causes physical and chemical changes - Evaluate negative and positive consequences of physical and chemical changes on the geosphere</p> <p>Learning & Behavioral Skills (Inquiry, Application in Society & Technology & Nature of...):</p>
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